

What is claimed is:

1. A processing system for chemically treating a substrate comprising:  
a temperature controlled chemical treatment chamber;  
a temperature controlled substrate holder mounted within said chemical treatment chamber and configured to be substantially thermally isolated from said chemical treatment chamber;  
a vacuum pumping system coupled to said chemical treatment chamber; and  
a gas distribution system coupled to said chemical treatment chamber and configured to introduce one or more process gases to said chemical treatment chamber in order to chemically alter exposed surface layers on said substrate, wherein said gas distribution system comprises a temperature controlled portion exposed to said one or more process gases in said chemical treatment chamber.
2. The processing system as recited in claim 1 further comprising a controller coupled to at least one of said temperature controlled chemical treatment chamber, said temperature controlled substrate holder, said vacuum pumping system, and said gas distribution system, and configured to perform at least one of setting, monitoring, and adjusting at least one of a chemical treatment chamber temperature, a chemical treatment substrate holder temperature, a chemical treatment substrate temperature, a chemical treatment gas distribution system temperature, a chemical treatment processing pressure for said vacuum pumping system, and a chemical treatment mass flow rate of said process gas for said gas distribution system.
3. The processing system as recited in claim 1, wherein said chemical treatment system is coupled to another processing system.
4. The processing system as recited in claim 1, wherein said chemical treatment system is coupled to at least one of a thermal treatment system and a substrate rinsing system.

5. The processing system as recited in claim 1, wherein said chemical treatment system is coupled to a transfer system.

6. The processing system as recited in claim 1, wherein said temperature controlled substrate holder comprises at least one of an electrostatic clamping system, a back-side gas supply system, and one or more temperature control elements.

7. The processing system as recited in claim 6, wherein said one or more temperature control elements comprise at least one of a cooling channel, a heating channel, a resistive heating element, a radiant lamp, and a thermo-electric device.

8. The processing system as recited in claim 1, wherein said temperature controlled chemical treatment chamber comprises at least one of a cooling channel, a heating channel, a resistive heating element, a radiant lamp, and a thermo-electric device.

9. The processing system as recited in claim 1, wherein said gas distribution system comprises at least one gas distribution plenum.

10. The processing system as recited in claim 1, wherein said gas distribution system comprises at least one gas distribution plate, said gas distribution plate comprises one or more gas injection orifices.

11. The processing system as recited in claim 1, wherein said one or more process gases comprise at least one of HF and NH<sub>3</sub>.

12. The processing system as recited in claim 1, wherein said one or more process gases comprise a first gas and a second gas different from said first gas.

13. The processing system as recited in claim 12, wherein said gas distribution system comprises a first gas distribution plenum and a first gas

distribution plate having a first array of one or more orifices and a second array of one or more orifices for coupling said first gas to said process space through said first array of one or more orifices in said first gas distribution plate, and a second gas distribution plenum and a second gas distribution plate having passages therein for coupling said second gas to said process space through said passages in said second gas distribution plate and said second array of one or more orifices in said first gas distribution plate.

14. The processing system as recited in claim 12, wherein said first gas is HF and said second gas is  $\text{NH}_3$ .

15. The processing system of claim 1, wherein said gas distribution system performs at least one of partial mixing and full mixing of said first gas and said second gas prior to introducing said first and second gases to said process space.

16. The processing system as recited in claim 1, wherein said first gas and said second gas are independently introduced to said process space without any interaction except in said process space.

17. The processing system as recited in claim 2, wherein said controller is configured to set said gas distribution system temperature at a temperature greater than said chemical treatment chamber temperature.

18. A method of operating a processing system to chemically treat a substrate comprising:

transferring said substrate into a chemical treatment system comprising a temperature controlled chemical treatment chamber, a temperature controlled substrate holder mounted within said chemical treatment chamber and configured to be substantially thermally insulated from said chemical treatment chamber, a vacuum pumping system coupled to said chemical treatment chamber, a gas distribution system configured to introduce one or more process gases into said chemical treatment chamber and having a temperature controlled portion exposed to said one or more process gases in

said chemical treatment chamber, and a controller coupled to said chemical treatment system;

setting chemical processing parameters for said chemical treatment system using said controller, wherein said chemical processing parameters comprise a chemical treatment processing pressure, a chemical treatment chamber temperature, a chemical treatment substrate temperature, a chemical treatment substrate holder temperature, and a chemical treatment gas flow rate; and

processing said substrate in said chemical treatment system using said chemical processing parameters in order to chemically alter exposed surface layers on said substrate.

19. The method as recited in claim 18, wherein said one or more process gases comprise a first gas having HF and a second gas having NH<sub>3</sub>.

20. The method as recited in claim 18, wherein said temperature controlled substrate holder comprises at least one of an electrostatic clamping system, a back-side gas supply system, and one or more temperature control elements.

21. The method as recited in claim 20, wherein said one or more temperature control elements comprise at least one of a cooling channel, a heating channel, a resistive heating element, a radiant lamp, and a thermo-electric device.

22. The method as recited in claim 18, wherein said temperature controlled chemical treatment chamber comprises at least one of a cooling channel, a heating channel, a resistive heating element, a radiant lamp, and a thermo-electric device.

23. The method as recited in claim 18, wherein said gas distribution system comprises at least one gas distribution plenum.

24. The method as recited in claim 18, wherein said gas distribution system comprises at least one gas distribution plate, said gas distribution plate comprises one or more gas injection orifices.

25. The method as recited in claim 18, wherein said gas distribution system comprises a first gas distribution plenum and a first gas distribution plate having a first array of one or more orifices and a second array of one or more orifices for coupling said first gas to said process space through said first array of one or more orifices in said first gas distribution plate, and a second gas distribution plenum and a second gas distribution plate having passages therein for coupling said second gas to said process space through said passages in said second gas distribution plate and said second array of one or more orifices in said first gas distribution plate.

26. The method as recited in claim 18, wherein said gas distribution system performs at least one of partial mixing and full mixing of said first gas and said second gas prior to introducing said first and second gases to said process space.

27. The method as recited in claim 18, wherein said first gas and said second gas are independently introduced to said process space without any interaction except in said process space.

28. The method as recited in claim 18, wherein said setting said chemical treatment chamber temperature includes heating said chemical treatment chamber using a wall temperature control unit and monitoring said chemical treatment chamber temperature.

29. The method as recited in claim 28, wherein said chemical treatment chamber temperature ranges from about 10° to about 200° C.

30. The method as recited in claim 18, wherein said setting said chemical treatment substrate holder temperature includes adjusting at least

one of said one or more temperature control elements and monitoring said chemical treatment substrate holder temperature.

31. The method as recited in claim 30, wherein said chemical treatment substrate holder temperature ranges from about 10° C to about 50° C.

32. The method as recited in claim 18, wherein said setting said chemical treatment substrate temperature includes adjusting at least one of said one or more temperature control elements, said backside gas supply system, and said clamping system, and monitoring said chemical treatment substrate temperature.

33. The method as recited in claim 32, wherein said chemical treatment substrate temperature ranges from about 10° C to about 50° C.

34. The method as recited in claim 18, wherein said setting said chemical treatment processing pressure includes adjusting at least one of said vacuum processing system and said gas distribution system, and monitoring said chemical treatment processing pressure.

35. The method as recited in claim 34, wherein said chemical treatment processing pressure ranges from about 1 to about 100 mTorr.

36. The method as recited in claim 18, wherein said one or more chemical processing parameters further comprises a chemical treatment gas distribution system temperature.

37. The method as recited in claim 36, wherein said setting said chemical treatment gas distribution system temperature includes heating said gas distribution system using a gas distribution system temperature control unit and monitoring said chemical treatment gas distribution system temperature.

38. The method as recited in claim 37, wherein said chemical treatment gas distribution system temperature ranges from about 10° to about 200° C.